



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/668,702	09/23/2003	Keng-Chu Lin	24061.22	2195
42717	7590	07/31/2006	EXAMINER	
HAYNES AND BOONE, LLP 901 MAIN STREET, SUITE 3100 DALLAS, TX 75202			GEBREMARIAM, SAMUEL A	
			ART UNIT	PAPER NUMBER
			2811	

DATE MAILED: 07/31/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

<p align="center">Office Action Summary</p>	Application No. 10/668,702	Applicant(s) LIN ET AL.	
	Examiner Samuel A. Gebremariam	Art Unit 2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 July 2006.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-17,21 and 23-25 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-17,21 and 23-25 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Request for Continued Examination

1. A request for continued examination (RCE) under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 7/13/2006 has been entered. An action on the RCE follows.
2. The amendment filed on 7/13/2006 has been entered.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1, 3-5, 12-14, 16-17, 21 and 23-24 are rejected under 35 U.S.C. 102(b) as being anticipated by Wu et al., US patent No. 6,013,581.

Regarding claim 1, Wu teaches (figs. 2A-2E) a semiconductor device having a first layer (206a) underlying a second layer (226), the method comprising: forming a glue layer (208) on the first layer (206); performing an inter-treatment on the glue layer (208); wherein the inter-treatment affects the upper and lower surfaces of the glue layer and improves an adhesive interface between the glue layer and the first layer (col. 3,

Art Unit: 2811

lines 37-50, since layer 208 is exposed to the plasma treatment the upper and lower surface of 208 are affected); and depositing the second layer (226) onto the upper surface of the inter-treated glue layer (208), wherein the inter-treated glue layer improves the adhesion between the first (206a) and the second layers (226), wherein the second layer is a metal layer (layer 226 comprises a metal layer).

The limitations of "a method for increasing a time dependent dielectric breakdown lifetime of a semiconductor device" is not given patentable weight because a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the prior art. See *In re Casey*, 152 USPQ 235 (CCPA 1967) and *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). Furthermore since Wu teaches the same claimed process, Wu's process is inherently capable of increasing a time dependent dielectric breakdown lifetime of the semiconductor device.

Regarding claim 3, Wu teaches the entire claimed process of claim 1 above including the inter-treatment on the glue layer includes applying plasma to the glue layer (col. 3, lines 37-50).

Regarding claim 4, Wu teaches the entire claimed process of claim 1 above including selecting a reacting gas, a process time, a process temperature, a process pressure, and a reacting gas flow (refer to col. 3, lines 37-50). Wu teaches performing

Art Unit: 2811

plasma treatment on the layer using different gases at certain plasma energy. Therefore Wu's process inherently requires adjusting reacting gas flow as indicated by the chemical formula, chamber temperature and process time.

Regarding claim 5, Wu teaches the entire claimed process of claim 1 above including the selected reacting gas is a hydrogen based gas (col. 3, lines 37-50).

Regarding claim 12, Wu teaches (figs. 2A-2E) a method comprising: depositing a dielectric layer (206a), depositing a glue layer (208) on the dielectric layer (206a); selecting a plasma treatment process (col. 3, lines 37-50); and applying the selected treatment process to affect the upper and lower surfaces of the glue layer (col. 3, lines 37-50, since layer 208 is exposed to the plasma treatment the upper and lower surface of 208 are affected); forming a metal layer (226) on the upper surface of the glue layer (206), wherein the treatment process enhances an adhesiveness between the dielectric layer (206a) and the metal layer (226, col. 3, lines 37-50).

The limitation of "a method for increasing a dielectric breakdown lifetime of a semiconductor device" is not given patentable weight because a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the prior art. See *In re Casey*, 152 USPQ 235 (CCPA 1967) and *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). Furthermore since Wu teaches the same claimed process, Wu's process is

Art Unit: 2811

inherently capable of increasing a time dependent dielectric breakdown lifetime of the semiconductor device.

Regarding claim 13, Wu teaches the entire claimed process of claim 1 above including the glue layer (208) with a certain thickness.

The limitation “the selected thickness is based at least partially on a desired electrical property of the glue layer” is not given patentable weight because the feature does not add anything to the process of forming the glue layer. Furthermore since Wu is concerned with forming interconnection structure therefore Wu’s process is inherently concerned with finding the desired electrical property of the glue layer.

Regarding claim 14, Wu teaches the entire claimed process of claim 1 above including adjusting a property of the selected treatment process based on the selected thickness of the glue layer.

Wu teaches forming the treatment over a certain depth of the glue layer (fig. 2D). Therefore Wu is inherently capable of adjusting a property of the selected treatment process based on the selected thickness of the glue layer.

Regarding claim 16, Wu teaches the entire claimed process of claims 1 and 12 above including the glue layer is silicon nitride (col. 3, lines 1-9).

Regarding claim 17, Wu teaches the entire claimed process of claims 1 and 12 above including the selected process is the plasma treatment process, and wherein a reacting gas to be used in the plasma treatment process is hydrogen based gas (col. 3, lines 37-50).

Art Unit: 2811

Regarding claim 21, Wu teaches (figs. 2A-2E) a method for improving an interface in a semiconductor device (col. 2, lines 50-53) comprising: forming a first metal layer (202); forming a glue layer (208) on the first metal layer (202); performing an inter-treatment on the glue layer to alter upper and lower surfaces of the glue layer for improved adhesiveness (col. 3, lines 37-50, the plasma process affects the upper and lower surface of the glue layer 208); and forming a second metal layer (226) on the upper surface of the glue layer (208).

Regarding claim 23, Wu teaches the entire claimed process of claim 21 above including the inter-treatment includes using plasma (col. 3, lines 37-50).

Regarding claim 24, Wu teaches the entire claimed process of claim 21 above including the material for the glue layer is SiN (col. 3, lines 1-9).

5. Claim 25 is rejected under 35 U.S.C. 102(b) as being anticipated by Dixit et al., US patent No. 6,355,558.

Dixit teaches (fig. 2C) forming a first metal layer (42); forming a glue layer (44, wetting layer, same as a glue layer) directly on the first metal layer (42); performing an inter-treatment on the glue layer to alter upper and lower surfaces of the glue layer (col. 4, lines 52-62) for improved adhesiveness, and forming a second metal layer (46) on the upper surface of the glue layer (44).

The limitations of "a method for improving an interface in a semiconductor device" is not given patentable weight because a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior

Art Unit: 2811

art. If the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the prior art. See *In re Casey*, 152 USPQ 235 (CCPA 1967) and *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). Furthermore since Dixit teaches the same claimed process, Dixit's process is inherently capable of improving an interface in a semiconductor device.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wu in view of Cox et al. US patent No. 5,851,927.

Wu teaches substantially the entire claimed process of claim 1 above except explicitly stating performing a pre-treatment on the first layer before forming the glue layer.

It is conventional and also taught by Cox performing a pre-treatment process on a silicon nitride film (col. 3, lines 15-32) in order to promote adhesion between the silicon nitride layer and subsequent layers.

Art Unit: 2811

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the pretreatment process taught by Cox in the method of Wu in order to promote adhesion between the first layer and the glue layer.

8. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wu in view of Xia et al. US patent No. 6,261,975.

Wu teaches substantially the entire claimed process of claims 1 and 4 above except explicitly stating that the selected reacting gas is a helium based gas.

It is conventional and also taught by Xia using helium based gas in the process of forming silicon oxide layer with an improved and stable layer (col. 8, lines 12-29).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the helium based gas taught by Xia in the process Wu in order to form glue layer that is stable (col. 8, lines 12-29).

9. Claims 7 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wu.

Regarding claim 7, Wu teaches substantially the entire claimed process of claims 1 and 4 above except explicitly stating that the selected process time is between approximately 1 and 100 seconds, the selected process temperature is between approximately 200 and 400° C, the selected process pressure is between approximately 0.5 and 10 torr, and the selected reacting gas flow is between approximately 100 and 2500 sccm.

Art Unit: 2811

Parameters such as process time, temperature, pressure and reacting gas flow in the art of semiconductor manufacturing process are subject to routine experimentation and optimization to achieve the desired film quality during device fabrication.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made adjust the process time, temperature, pressure and flow as claimed in the process of Wu in order to form a high quality glue layer.

Regarding claim 15, Wu teaches substantially the entire claimed process of claims 1 and 14 above except explicitly stating duration of the selected treatment process.

Parameters such as process time are subject to routine experimentation and optimization to achieve the desired film quality during device fabrication.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made adjust the process time as claimed in the process of Wu in order to form a high quality glue layer.

10. Claims 8-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wu in view of Murokh et al. US patent No. 5,798,146.

Regarding claim 8, Wu teaches substantially the entire claimed process of claim 1 above except explicitly stating performing the inter-treatment on the glue layer includes directing an electron beam towards the glue layer.

Art Unit: 2811

Murokh teaches (col. 1, lines 34-46) the application of electron beam on a dielectric layer in order to improve to the wettability and adhesive characteristics.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the process of applying electron beam on the dielectric layer taught by Murokh in the process of Wu in order to improve the adhesive characteristics of the glue layer.

Regarding claim 9, Wu teaches substantially the entire claimed process of claims 1 and 8 above including directing the electron beam towards the glue layer further comprises defining a process power and a dosage. Since applying electron beam requires using a certain amount of process power and electron beam density, the combined process of Wu and Murokh inherently teaches defining a process power and a dosage.

Regarding claims 10 and 11, Wu teaches substantially the entire claimed process of claims 1 and 8 above except explicitly stating that the process power is between approximately 1000 eV and 8000 eV and the dosage is between approximately 50 and 500 $\mu\text{C}/\text{cm}^2$.

Parameters such as process power and electron beam dosage in the art of semiconductor manufacturing process are subject to routine experimentation and optimization to achieve the desired film quality during device fabrication.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made adjust the process power and beam dosage as claimed in

Art Unit: 2811

the process of Wu in order to order to improve the adhesive characteristics of the glue layer.

Response to Arguments

11. Applicant's arguments filed 7/13/2006 have been fully considered but they are not persuasive. Applicant argues the structure of Wu et al. does not include a metal layer deposited onto the upper surface of an inter-treated glue layer as recited in claims 1, 12. As stated above, Wu teaches a metal layer (226) on the upper surface of the inter-treated glue layer (208). The limitation of the metal layer being formed on the upper surface of the inter-treated glue layer does not imply that the metal layer is formed directly on the inter-treated glue layer.

With regards to claim 21, applicant argues that Wu does not include forming a glue layer on a first metal layer. However the limitation "on" does not preclude the formation of intermediate layers between the first metal layer and the glue layer.

Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Samuel A. Gebremariam whose telephone number is (571)-272-1653. The examiner can normally be reached on 8:00am-4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on (571) 272-1732. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2811

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SAG
July 23, 2006

Douglas W. Owens 7/24/06

DOUGLAS W. OWENS
PRIMARY EXAMINER